Contract No.: N00104-85-C-3286

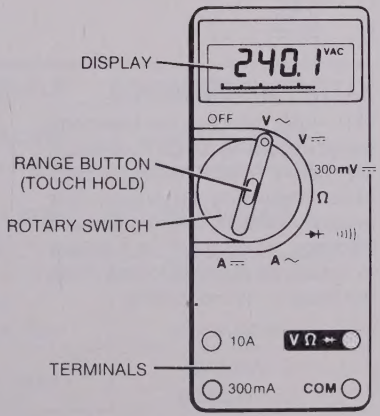
77/AN
Multimeter

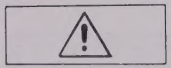
Operator's Manual

FLUKE®

INDEX

DESCRIPTION	Page
SAFETY INFORMATION	2
FEATURES	
Display Features	6
Analog Display	8
Autorange	9
Range Hold	10
Touch Hold	11
OPERATION	
Voltage Measurement	14
Resistance Measurement	15
Diode Test	16
Continuity Beeper	17
Current Measurement	18
OPERATOR MAINTENANCE	20
SPECIFICATIONS	24





SAFETY INFORMATION

This meter has been designed and tested according to IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus. This manual contains information and warnings which must be followed to ensure safe operation and retain the meter in safe condition.

SAFETY SYMBOLS

Indicates the operator must refer to an explanation in this manual.

Indicates terminals at which dangerous voltages may exist.

MULTIMETER SYMBOLS

- AC rms
- DC
- Fuse
- Double Insulation (Protection Class II)
- Battery
- AC Source
- Audio
- Diode Test
- Red Test Lead
- Black Test Lead

WARNING

TO AVOID ELECTRICAL SHOCK OR DAMAGE TO METER, DO NOT APPLY MORE THAN 1000Vdc OR AC BETWEEN ANY TERMINAL AND EARTH GROUND.

CAUTION

TO AVOID DAMAGE TO METER, DO NOT EXCEED THE INPUT LIMITS SHOWN AT RIGHT. The A~ and A⎓ input limits are explained further under "Current Measurement."

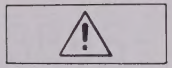
FUNCTION	TERMINALS	INPUT LIMITS
V~ (VAC) V⎓ (Vdc)	VΩ⊣⊢& COM	1000V⎓ 750V ~
300mV⎓ (Vdc) Ω ⊣⊢ ıılı)	VΩ⊣⊢& COM	500V⎓ 500V~
A~ (AC) A⎓ (dc)	300mA & COM or 300mA & 10A	320mA/600V⎓ . 320mA/600V ~
	10A & COM	20A/600V⎓ 20A/600V ~*

* 10A continuous
20A for 30 sec. max.

WARNING

THE 10A RANGE IS NOT FUSE-PROTECTED. TO AVOID DAMAGE OR INJURY, USE METER ONLY IN CIRCUITS LIMITED BY FUSE OR CIRCUIT BREAKER TO 20A OR 4000 VA. THIS METER IS NOT INTENDED FOR HIGH-ENERGY CIRCUITS.

This restriction ensures protection against burns in the event a voltage is accidentally applied between the 10A and COM terminals. To avoid accidentally applying voltage to the 10A terminal, verify that the red test lead is connected to the V input terminal before making a voltage measurement.



WARNING

TO AVOID ELECTRICAL SHOCK:

• USE CAUTION WHEN WORKING ABOVE 60Vdc OR 25VAC rms. SUCH VOLTAGES POSE A SHOCK HAZARD.

• ENSURE TEST LEADS ARE IN GOOD CONDITION.

CAUTION

TO AVOID DAMAGE TO METER:

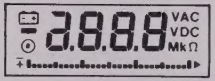
• ABOVE 500V, DISCONNECT TEST LEADS FROM TEST POINTS BEFORE CHANGING FUNCTIONS.

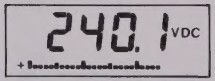
• CLEAN CASE WITH DAMP CLOTH AND MILD DETERGENT, NOT ABRASIVES OR SOLVENTS.

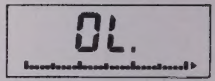
OPERATING HINTS

• For correct readings in Ω and →+ıılı) , ensure power is off in device being tested.

• Environments with rf noise or arcing may cause improper display of symbols; to reset meter, momentarily turn rotary switch to OFF.







POWER-UP SELF-TEST

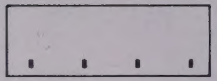
When the meter is turned on, all display segments appear while the instrument performs a brief self-test. At the end of the test, the meter chirps once and begins taking readings.

READINGS

The digital display is updated 2½ times per second. For negative voltage or current readings, a minus (–) sign appears next to the first digit. The analog display gives a graphic indication of the input level; it is updated 25 times per second, and has separate polarity indicators.

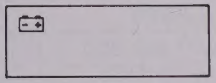
OVERLOAD INDICATION

These symbols indicate the input is too large to display. (The location of the decimal point depends on the measurement range.) Select the next higher range.



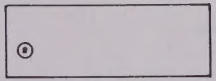
STANDBY

To extend battery life, the display blanks after 1 hour (20 minutes in →+)))), if the meter is not being used. To resume operation, turn the rotary switch.



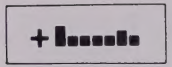
LOW BATTERY INDICATOR

This symbol appears when approximately 100 hours of battery life remain. For proper operation, replace the battery as soon as possible.



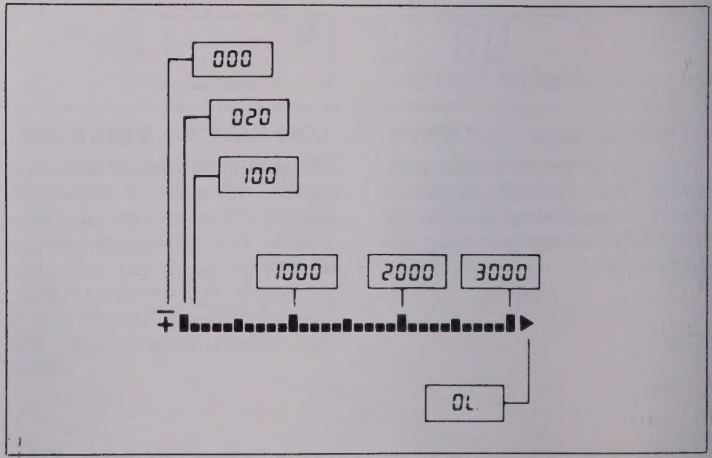
RANGE HOLD & TOUCH HOLD

This symbol indicates that either Range Hold or Touch Hold is activated.



ANALOG DISPLAY

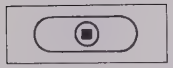
The analog display is especially helpful for peaking and nulling and for observing rapidly changing inputs. The bar indicates the magnitude of the input compared to the full scale value of the measurement range in use. (See right.) In V⎓, 300mV⎓, and A⎓, a + or − indicates the polarity of the input. (Near zero, the + and − blink evenly.) In all other functions, the + disappears, but the − still appears near zero.



FUNCTION	RANGE	DISPLAY
V~ V ⎓	3.2V	g.ddd VAC/Vdc
	32V	gd.dd VAC/Vdc
	320V	gdd.d VAC/Vdc
	1000V	gddd VAC/Vdc
300mV ⎓	320mV	gdd.d
Ω	320Ω	gdd.dΩ
	3200Ω	gdddΩ
	32kΩ	gd.ddΩ
	320kΩ	gdd.dkΩ
	3.2MΩ	g.dddMΩ
	32MΩ	gd.ddMΩ
→+)))	2V	g.ddd
A~ A ⎓	32mA	gd.dd AC/dc
	320mA	gdd.d AC/dc
	10A	gd.dd AC/dc

AUTORANGE

The meter powers up in autorange. In autorange, the meter automatically selects the measurement range that gives the best resolution. The display indicates Ol while the meter goes to a higher range, and blanks while the meter goes to a lower range. The range can be interpreted from the display as shown in the table at left. (In this table, d = digit and g = 1, 2, or 3 only.)



RANGE HOLD

Range Hold lets you select a fixed measurement range. The display will indicate OL if a measurement is too large to display in the selected range. If the display indicates OL, select the next higher range.

TO ENABLE RANGE HOLD:

1. Turn rotary switch to any function except 300mV ⎓ or →|◁)), and press range button. Meter will display ⊙.

2. Press range button again to change range. Meter will chirp once for each change.

TO RETURN TO AUTORANGE:

Press range button for 1 second. Meter will chirp twice and return to autorange.

TOUCH HOLD

In Touch Hold, the meter "captures" a reading when the test leads touch a circuit or when the range button is pressed. This lets you lift the test leads before reading the display.

FURTHER UNDERSTANDING:

The meter will capture a reading if the input is constant for ½ second and differs from the previous reading by at least 1 segment of the analog display. However, it will not capture a reading if the input is overrange or near zero volts or amps. *In some functions, therefore, the meter may not display a reading upon power-up.* Pressing the range button will force a reading. Touch Hold is always in autorange, so the meter will up-range if necessary.

Open test leads in noisy environments may pick up stray signals. It is therefore possible for an unwanted update (signaled by an extra beep) to occur. An unwanted update is most likely to occur in one of the following situations:

1. When test leads are exposed to large RF or other AC fields.

2. When one test lead is connected to a voltage source, and the other test lead body is held by the operator.

3. When the high side (red) metal probe tip is touched by the operator.

4. When used in high voltage environments where dielectric energy, stored in materials and on operators' hands, is released slowly into open leads just after making a

Touch-Hold measurement above a few hundred volts.

To reduce the likelihood of a spurious reading, the following precautions are recommended:

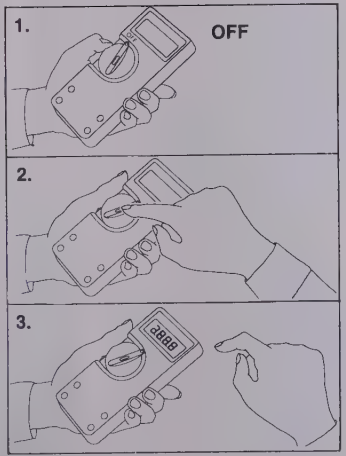
1. Connect the COM lead (black) firmly to circuit ground, or earth, before using Touch-Hold. If both probes are hand-held, and circuit ground is unknown or unavailable, try to touch both probes to the measured circuit simultaneously.

2. Minimize hand contact with test probes; a good technique is to hold the probes with fingertips only.

3. Short the probe leads together as soon as possible after a Touch-Hold reading has been acquired.

4. Use shielded test leads or a coaxial cable adapter.

5. For high voltage measurements, separate test leads from each other (do not twist together).



TO ACTIVATE TOUCH HOLD:

1. Turn rotary switch to OFF.

2. While pressing range button, turn rotary switch to any function.

3. When display segments appear clearly, release range button. TO DEACTIVATE: Turn rotary switch to OFF.

TO USE TOUCH HOLD:

1. Touch test leads to test points. Meter will take reading and beep.

2. Disconnect test leads from test points. Meter will hold reading in display.

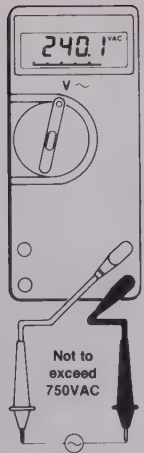
3. Read display.

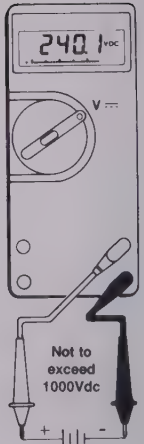
V~
V⎓
300mV⎓ **V**

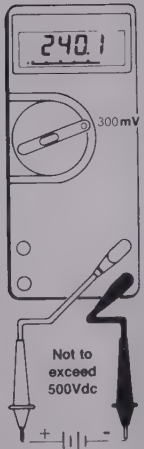
Refer to the warnings and cautions on pages 3 and 5.

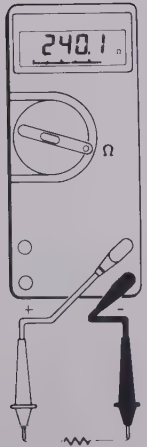
VOLTAGE MEASUREMENT

Select the VAC or Vdc function (V~ or V⎓) and connect the test leads as shown. Select the 300mV⎓ function for best resolution below 320mVdc. In the 300mV⎓ function, readings are displayed in mV and the Vdc symbol blanks.









Refer to the warning and caution on page 3.

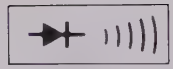
Ω

RESISTANCE MEASUREMENT

Connect the test leads as shown. Units are indicated by Ω, kΩ, or MΩ in the display. For correct readings, ensure that the device being tested contains no voltage. (Negative readings may result if voltage is present.)

CAUTION

VOLTAGES EXCEEDING 500V MAY DAMAGE METER.

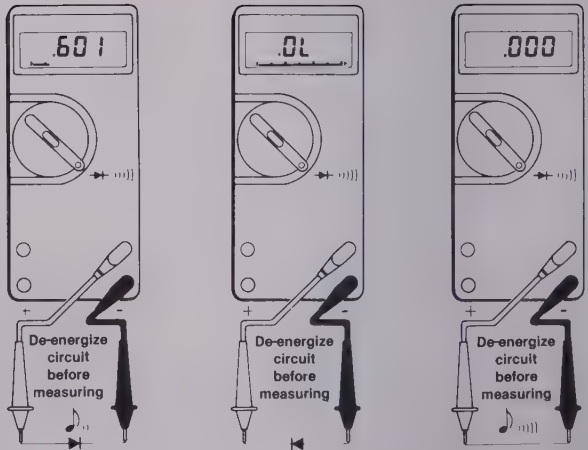


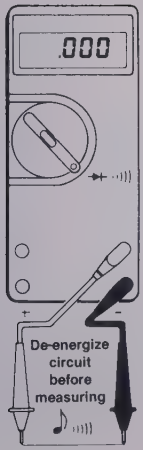
DIODE TEST

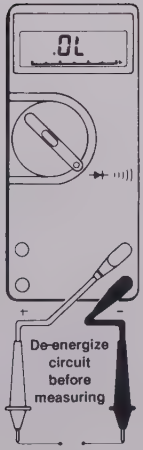
Forward bias: The meter displays the forward voltage drop (V_F) in volts up to 2V, and beeps briefly for one diode drop ($V_F < 0.7V$). *Reverse bias or open circuit:* The meter displays OL. *Short circuit:* The meter emits a continuous tone.

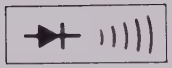
CAUTION

VOLTAGES EXCEEDING 500V MAY DAMAGE METER.









CONTINUITY BEEPER

A continuous tone sounds if the resistance between the terminals is less than approximately 150Ω (100 counts in display). The display indicates the approximate test voltage across the terminals. (In Touch Hold, continuity causes 2 beeps.)

CAUTION

VOLTAGES EXCEEDING 500V MAY DAMAGE METER.

A~
A⎓ **A**

Refer to page 4.

CURRENT MEASUREMENT

CAUTION

DE-ENERGIZE THE CIRCUIT BEFORE CONNECTING TEST LEADS IN SERIES WITH THE LOAD.

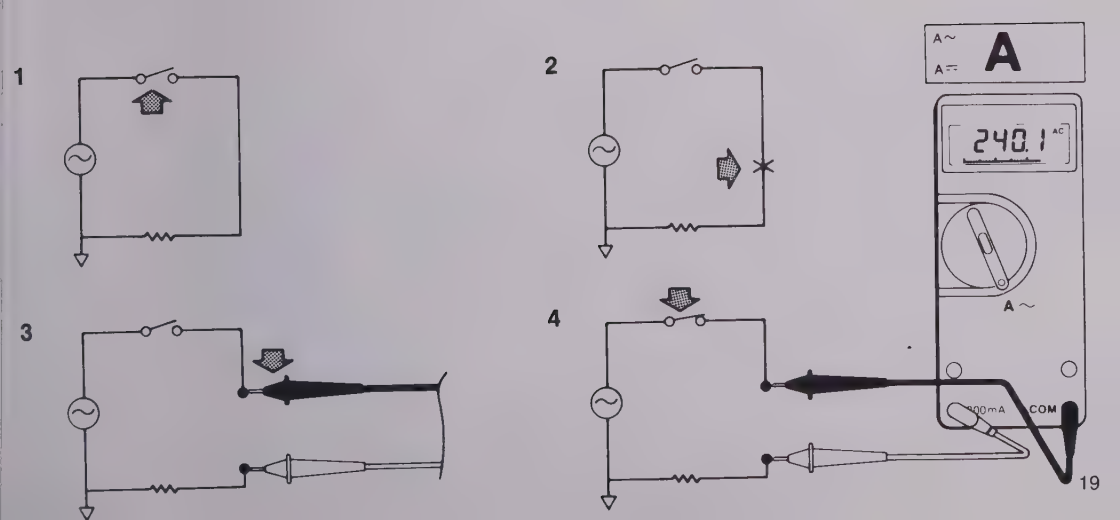
Refer to illustration on page 19 for correct sequence to measure current. Make sure connections are secure and function switch is in ampere position (A~ or A⎓) before energizing circuit. De-energize circuit before removing test leads from circuit and reconnecting break in circuit (step 2).

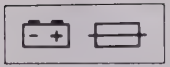
Be sure to replace test leads in voltage terminals and return function switch to voltage position (V~ or V⎓) before making subsequent voltage measurements.

Select the AC or dc function (A~ or A⎓). For measurements up to 320mA, connect the test leads to the 300mA and COM terminals, or alternatively, to the 300mA and 10A terminals (not illustrated).

The 300mA terminal is limited to 630mA by a protective fuse and a protective resistor. If the fuse blows, the meter will display approximately zero. A fuse test is shown in "OPERATOR MAINTENANCE."

For measurements up to 10A, use the 10A and COM terminals. The 10A and COM terminals may also be used for measurements between 10A and 20A for up to 30 seconds. Exceeding 30 seconds or 20A may damage your meter.


1
2
3
4
A~
A⎓
A
240.1
A~
COM



OPERATOR MAINTENANCE

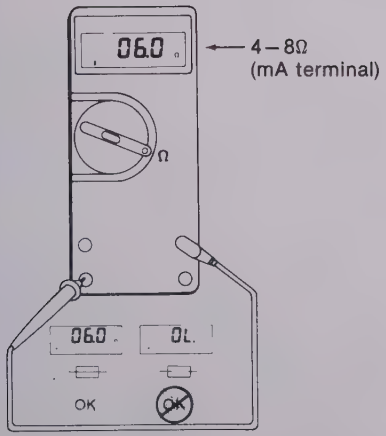
A. Internal Fuse Test
B. Battery/Fuse Replacement
C. Calibration Procedure

WARNING

TO AVOID ELECTRICAL SHOCK, REMOVE TEST LEADS BEFORE OPENING CASE, AND CLOSE CASE BEFORE OPERATING METER. TO PREVENT FIRE, INSTALL FUSES WITH RATING SHOWN ON BACK OF METER.

CAUTION

TO AVOID DAMAGING COMPONENTS, LIFT END OF BATTERY UPWARD AS SHOWN; DO NOT PULL BATTERY STRAIGHT OUT. TO AVOID CONTAMINATION OR STATIC DAMAGE, DO NOT TOUCH ROTARY SWITCH OR CIRCUIT BOARD.

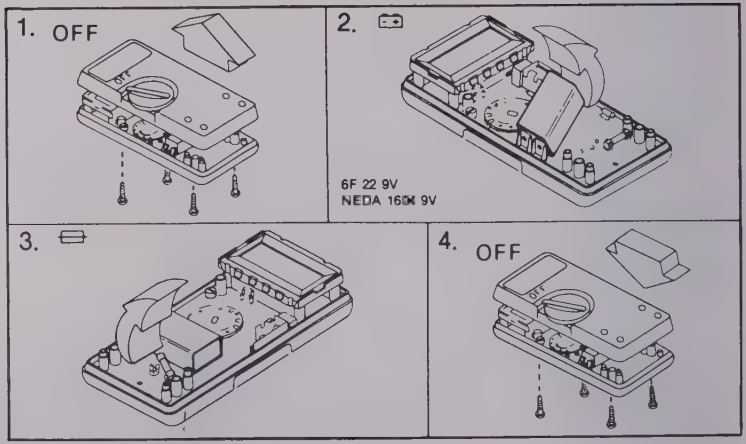


A. FUSE TEST

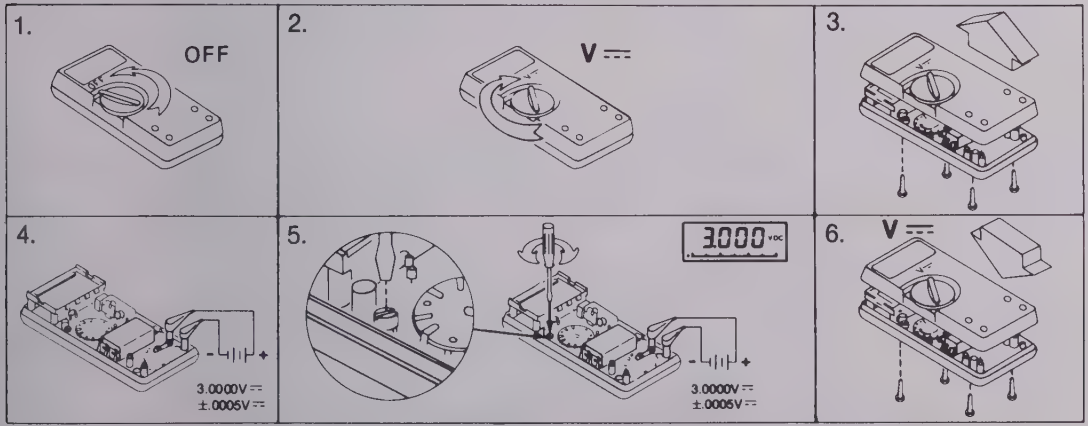
WARNING

IF IMPROPER FUSES ARE USED, DAMAGE TO THE METER AND POSSIBLE ELECTRICAL SHOCK MAY OCCUR.

B. ⚠ BATTERY/FUSE REPLACEMENT



C. ⚠ CALIBRATION TO BE PERFORMED BY A QUALIFIED TECHNICIAN ONLY.



SPECIFICATIONS

Item	Description
Operating Temperature	0°C to 50°C
Storage Temperature	– 40°C to + 60°C
Relative Humidity	
All ranges except 32 MΩ	0% to 90% (0°C to 35°C) 0% to 70% (35°C to 50°C)
32 MΩ range only	0% to 80% (0°C to 35°C) 0% to 70% (35°C to 50°C)
Temperature Coefficient	0.1 x (specified accuracy)/°C (applies from 0°C to 20°C and from 30°C to 50°C)

Item	Description
Battery Type	NEDA 1604 9V or 6F 22 9V
Battery Life (typical)	1600 hrs Zn-C 2000 + hrs alkaline
Size (HxWxL)	2.84cm x 7.49cm x 16.64 cm (1.12 in x 2.95 in x 6.55 in)
Weight	0.34kg (12 ounces)
Safety Rating	Protection Class II per IEC 348

FUNCTION	RANGE	RESOLUTION	ACCURACY
V⎓	3.2V	0.001V	±(1+1)*
	32V	0.01V	±(1+1)
	320V	0.1V	±(1+1)
	1000V	1V	±(1.3+1)
300mV⎓	320mV	0.1mV	±(1+1)
V~ 45Hz-1kHz	3.2V	0.001V	±(4+2)
	32V	0.01V	±(4+2)
	320V	0.1V	±(4+2)
(45-500Hz)	750V	1V	±(4+2)
Ω	320Ω	0.1Ω	±(2+2)
	3200Ω	1.0Ω	±(2+1)
	32kΩ	0.01kΩ	±(2+1)
	320kΩ	0.1kΩ	±(2+1)
	3.2MΩ	0.001MΩ	±(2+1)
	32MΩ	0.01MΩ	±(3+1)
→+)))	2.0V	0.001V	±(1+1) typical

SPECIFICATIONS

FUNCTION	RANGE	RESOLUTION	ACCURACY	FULL SCALE BURDEN VOLTAGE (Typical)
A ⎓	32mA	0.01mA	±(3+2)*	0.2V*
	320mA	0.1mA	±(3+2)	2.0V
	10A	0.01A	±(3+2)	0.5V
A ∼ 45Hz-1kHz (typical)	32mA	0.01mA	±(5+2)	0.2V
	320mA	0.1mA	±(5+2)	2.0V
	10A	0.01A	±(5+2)	0.5V

* Basic electrical specifications are defined over the temperature range from 20 to 30 degrees C for a period of one year after calibration

Accuracy is specified as ±([% of reading] + [number of units in least significant digit]). In Touch Hold, accuracy is not specified for 300mV ⎓ and Ω functions when test circuit impedance exceeds 1MΩ.

V∼ and A∼ are average responding, calibrated for the rms value of sine waves.

Useful frequency response (typical) for 32V and 320V ranges, −0.5dB at 10kHz, for 3.2V and 750V ranges, ±3dB at 5kHz.

FUNCTION	MAXIMUM INPUT VOLTAGE (across input terminals	RESPONSE TIME (of digital display to rated accuracy)	INPUT IMPEDANCE	COMMON MODE REJECT ON RATIO (1kΩ unbalance)	NORMAL MODE REJECTION RATIO (digital display only)
V ~	1000Vdc 750VAC rms (sine)	<2s	>10MΩ in parallel with <50pF (AC coupled)	>60dB (dc to 60Hz)	
V ⎓	1000Vdc 750VAC rms (sine)	<1s	>10MΩ (input capacitance: <50pF)	>120dB (dc, 50Hz, or 60Hz)	>60dB (dc, 50Hz, or 60Hz)
300mV ⎓	500Vdc 500VAC rms (sine)	<1s	10MΩ (input capacitance: <50pF)	>120dB (dc, 50Hz, or 60Hz)	>60dB (dc, 50Hz, or 60Hz)

FUNCTION	MAXIMUM OVERLOAD (across input terminals)	RESPONSE TIME (of digital display to rated accuracy)	OPEN CIRCUIT TEST VOLTAGE (0°C to 50° C)	FULL SCALE VOLTAGE (0°C to 50°C)	
				Up to 3.2MΩ	Up to 32MΩ
Ω	500 Vdc 500VAC rms (sine)	<1s (up to 320kΩ) <2s (up to 3.2MΩ) <10s (up to 32MΩ)	<3.1Vdc (<2.8Vdc typical)	<440mVdc (<420mVdc typical)	<1.4Vdc (<1.3Vdc typical)

SPECIFICATIONS

MAXIMUM VOLTAGE BETWEEN ANY TERMINAL AND EARTH GROUND (all functions)
1000Vdc 750VAC rms (sine)

FUSE PROTECTION
(300mA Terminal) 630mA/250V/1500A Interrupt Capacity Fusible Resistor (10A Terminal) Unfused

FUNCTION	**MAXIMUM OVER-LOAD** (across input terminals	**TEST CURRENT**	
		Test Current (typical)	V_F
→||||	500Vdc 500VAC rms (sine)	0.7mA 0.5mA 0.3mA 0.1mA	0.0V 0.6V 1.2V 2.0V

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